H2 Fueling Station Costs and Economic Analysis

Public Meeting

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Diamond Bar
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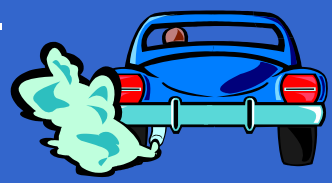
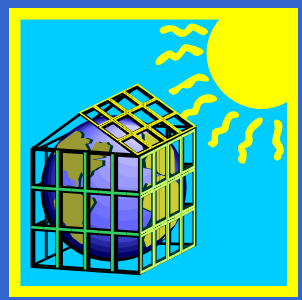
Why are we doing this?

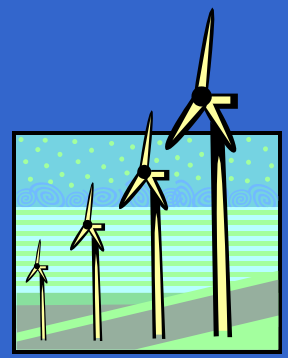
- Customer and manufacturer benefits
  - Vehicle design flexibility
  - Reduce maintenance, e.g., no oil changes
  - Quiet operation

- No on-road emissions of PM, NO_x, etc.
  - Reduce the number of local emission sources





- Global warming (CO_2) reduction potential



- Pathway to a sustainable future
  - Reduce petroleum imports
  - Accelerate the use of renewable power

What challenges remain?

- *Hydrogen Infrastructure*: A significant financial investment over a long period of time is required to develop the infrastructure for producing, storing, and delivering hydrogen
- *Reliability & Cost of Fuel cell systems:* Cost must be reduced and reliability improved
- *Hydrogen Storage*: Current options for storing hydrogen on-board the vehicle are not sufficient for commercial introduction

Infrastructure Development

2005 — Transition Issues — 2030-2050?

- Fleet vehicles
- Low H_2 demand – high risk
- Low production volumes
- High permitting, site preparation, insurance costs
- Subsidies, tax holiday?
- Small scale production and merchant LH_2 delivery
- Production from natural gas and wind or grid power

- Public fueling
- High H_2 demand – lower risk
- High production volumes
- Well-established permitting, site preparation, insurance costs
- Unsubsidized?
- Large scale production with pipeline delivery
- Additional production from coal, biomass, nuclear, renewables

H2A Background

- Ad-hoc group of analysts, national labs, and industry collaborators brought together by US DOE
- Primary goal: bring consistency & transparency to hydrogen analysis (primarily cost assessments)
- First H2A meeting February 2003
- Work still in progress – models and detailed inputs/results to be made available this Fall

H2A Approach

- Discounted cash flow analysis
  - Estimates levelized price of hydrogen for desired internal rate of return
  - Takes into account capital costs, construction time, taxes, depreciation, O&M, inflation, and projected feedstock prices
- Base the costs primarily on previously published studies
- Identify key cost drivers through sensitivity analyses
- Obtain peer review and input from key industrial collaborators (KIC)

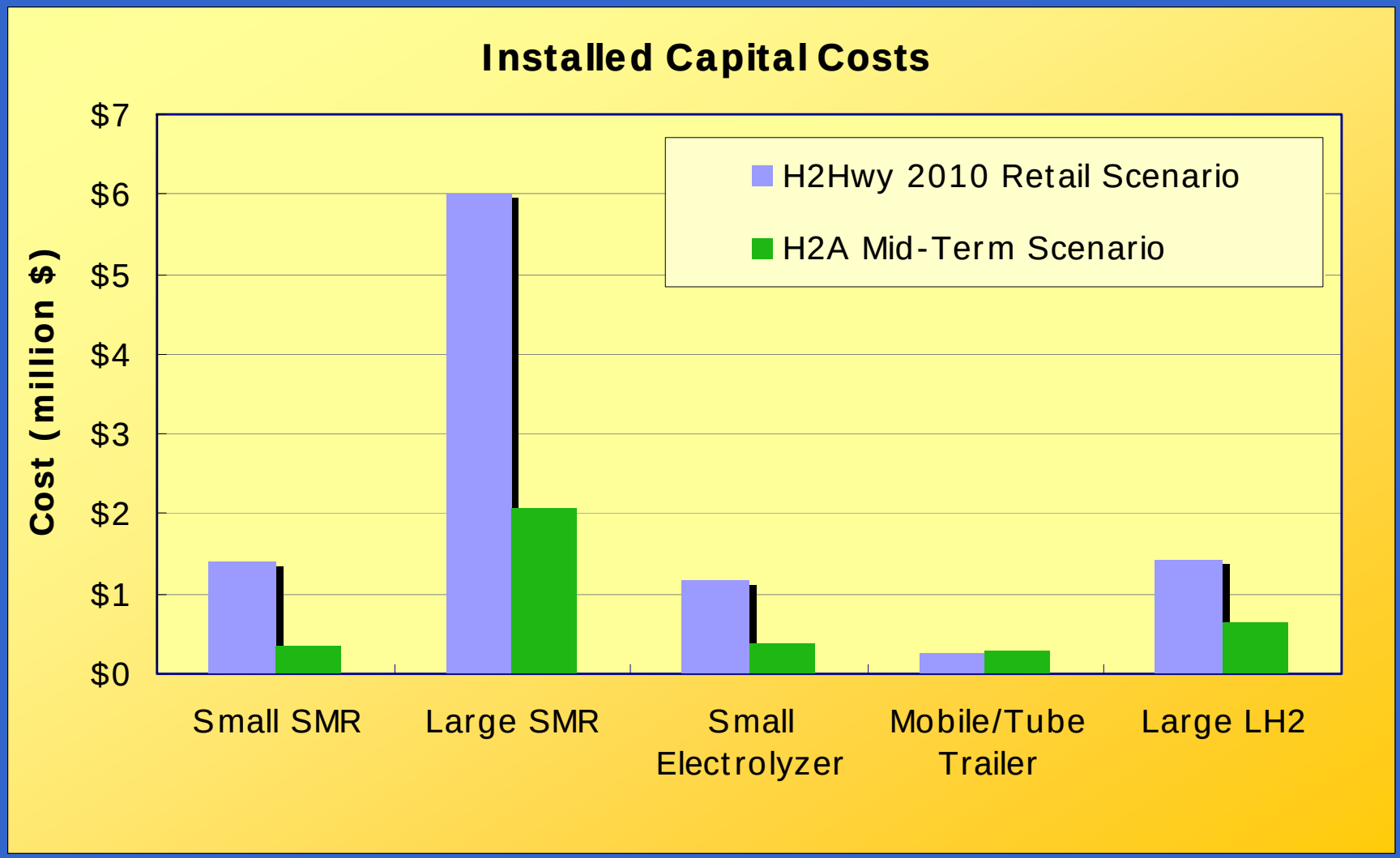
H2A Cases and Teams

- Central
  - > 50,000 kg/day H_2
  - N'th Plant
  - Current (2005), Mid-Term (~2015), Long Term (~2030)
  - Team: Maggie Mann (NREL), Johanna Ivy (NREL), Dan Mears (Technology Insights), Mike Rutkowski (Parsons Engineering)
- Delivery
  - Components and Scenarios
  - Team: Joan Ogden (UC Davis), Marianne Mintz (ANL), Matt Ringer (NREL), John Molberg (ANL), Jerry Gilette (ANL)
- Forecourt
  - 100 and 1,500 kg/day $H_{2\backslash}$
  - N'th plant: with 500 units per year
  - Current (2005), Mid-Term (~2015), Long Term (~2030)
  - Team: Steve Lasher (TIAX), Brian James (Directed Technologies, Inc.), Matt Ringer (NREL)
- Finance, feedstocks & utilities, and methodology
  - Marylynn Placet (PNNL)
- Environmental assessment
  - Michael Wang (ANL)

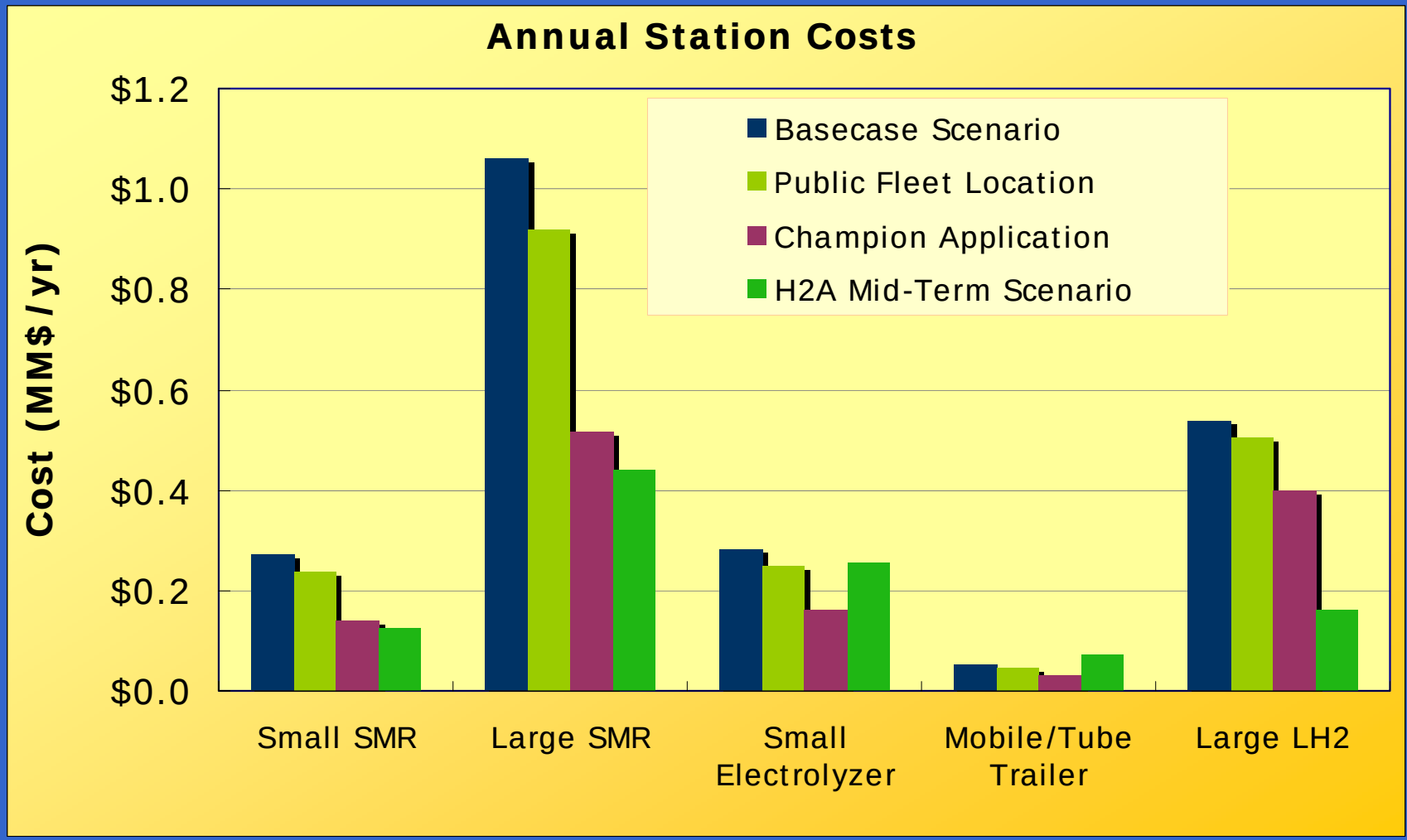
Key Assumptions

Design and Financial Assumptions	H2Hwy Baseline	H2A
Design capacity (kg H2/day)	100/1000	100/1500
Capacity factor	10%	70%
Assumed production volume (per year)	Current level	500+
Natural gas ($/MMBtu)	7.00	Varies
Electricity ($/kWh)	0.10	Varies
Delivered H2 cost ($/kg)	4.50	NA
Internal rate of return	10% ?	10%
Analysis period (years)	15	20
Labor rate ($/hr)	15.00	15.00
% of labor allocated to fuel sales	50%	50%
G&A rate (% of labor)	None	25%
Real estate cost ($/ft^2/month)	0.50	0.50
Contingency	20%	10%

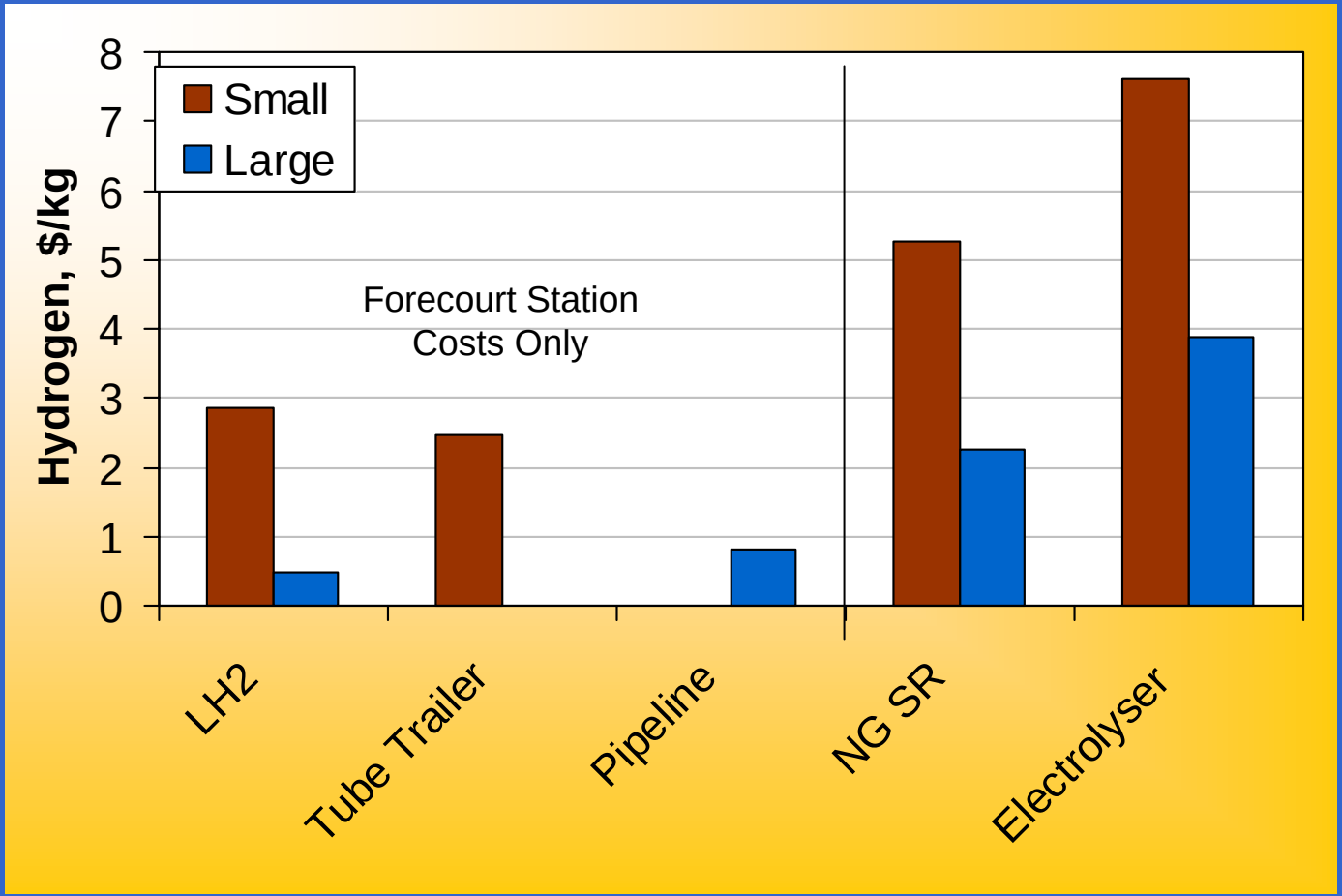
Capital Costs



Annual Costs



H2A Results – Mature H_2 Cost



Reference: Lasher, S. et al., "Forecourt Team Overview," NHA Conference, May 2004.